

From the researches of the late Professor H. A. Newton, and the results of the investigations of Drs. Stoney and Downing on the perturbations of Adams's orbit, the most probable value of the period of revolution would appear to be at present about 33·49 years, corresponding to mean distance of 10·39.

Any admissible variation in the length of the period, however, makes but a small change in the other elements of the orbit, as is evident from Table V, in which the elements in each column have been computed with the value of the mean distance which is contained in it.

Table V.

	I.	II.	III.
(Assumed) period P =	33·25 yrs.	33·49 yrs.	33·73 yrs.
Mean distance a =	10·34	10·39	10·44
Angle of eccentricity ϕ =	64° 46'	64° 50'	64° 54'
Inclination i =	16 3	16 3	16 3
Longitude of descending node ν =	53 2	53 2	53 2
Longitude of perihelion π =	58 40	58 40	58 40

If we adopt the value 10·39 for the mean distance, as being on the whole the most probable, we have the orbit in column II representing the result of the observations of 1898, as far as they have been published.

“A Comparison of Platinum and Gas Thermometers, including a Determination of the Boiling Point of Sulphur on the Nitrogen Scale: an Account of Experiments made in the Laboratory of the Bureau International des Poids et Mesures, at Sèvres.” By Drs. J. A. HARKER and P. CHAPPUIS. Communicated by the KEW OBSERVATORY COMMITTEE. Received June 8,—Read June 15, 1899.

(Abstract.)

In 1886, Professor Callendar drew attention to the method of measuring temperature, based on the determination of the electrical resistance of a platinum wire. He showed that the method was capable of a very general application, and that the platinum resistance thermometer was an instrument giving consistent and accurate results over a very wide temperature range.

Callendar pointed out that if R_0 denote the resistance of the spiral of a particular platinum thermometer at 0°, and R_1 its resistance at 100°, we may establish for the particular wire a temperature scale,

which we may call *the scale of platinum temperatures*, such that if R be the resistance at any temperature T° , this temperature on the platinum scale will be $\frac{R}{R_1 - R_0} \times 100$ degrees. For this quantity Callendar employs the symbol pt , its value depending on the sample of platinum chosen.

In order to reduce to the standard scale of temperature the indications of any platinum thermometer, it is necessary to know the law connecting T and pt . These are, of course, identical at 0° and 100° , but the determination of the curve expressing the relationship between them is a matter for experiment.

The work of Callendar had established for a particular sample of platinum the relation

$$d = T - pt = \delta \left[\left(\frac{T}{100} \right)^2 - \frac{T}{100} \right]$$

over the range 0° to 600° , T being measured on the constant pressure air scale.

Later experiments by Callendar and Griffiths showed that this relation holds for platinum wires generally, provided they are not very impure. They propose that the value of δ , the constant employed in the formula, should be determined by taking the resistance of the thermometer in the vapour of sulphur. A new determination of this point on the air scale made by them gave 444.53° , as the boiling point under 760 mm. pressure.

The present paper is the outcome of the co-operation of the Kew Observatory Committee and the authorities of the International Bureau of Weights and Measures at Sèvres, for the purpose of carrying out a comparison of some platinum thermometers with the recognised international standards.

A new resistance-box, designed for this work, and special platinum thermometers together with the other accessories needed were constructed for the Kew Committee, and after their working had been tested at Kew, were set up at the laboratory at Sèvres in August, 1897. The comparisons executed between these instruments and the standards of the Bureau may be divided into several groups. The first group of experiments covers the range -23° to 80° , and consists of direct comparisons between each platinum thermometer and the primary mercury standards of the Bureau. Above 80° the mercury thermometers were replaced by a gas-thermometer, constructed for measurements up to high temperatures. The comparisons between 80° and 200° were made in a vertical bath of stirred oil, heated by different liquids boiling under varying pressures. For work above 200° a bath of mixed nitrates of potash and soda was substituted for the oil tank. In this bath comparisons of the two principal platinum thermometers with the gas-thermometer were made up to 460° ; and with a third

thermometer, which was provided with a porcelain tube, we were able to go up to 590°. Comparisons of the platinum and gas-scales were carried out at over 150 different points, each comparison consisting of either ten or twenty readings of the different instruments.

By the intermediary of the platinum thermometers a determination of the boiling point of sulphur on the nitrogen scale was also made. The mean of three very concordant sets of determinations with the different thermometers gave 445°·27 as the boiling point on the scale of the constant volume nitrogen thermometer, a value differing only 0°·7 from that found by Callendar and Griffiths for the same temperature expressed on the constant pressure air scale.

If for the reduction of the platinum temperatures in our comparisons we adopt the parabolic formula, and the value of δ obtained by assuming our new number for the sulphur-point, we find that below 100° the differences between the observed values on the nitrogen scale and those deduced from the platinum thermometer are exceedingly small, and that even at the highest temperatures the differences only amount to a few tenths of a degree.

Full details as to the instruments employed and the methods adopted are given in the paper.

“Agricultural, Botanical, and Chemical Results of Experiments on the Mixed Herbage of Permanent Grass-land, conducted for many Years in succession on the same Land. Part III.—The Chemical Results.” By Sir JOHN BENNET LAWES, Bart., D.C.L., Sc.D., F.R.S., and Sir J. HENRY GILBERT, LL.D., Sc.D., F.R.S. Received August 10, 1899.

(Abstract.)

The experiments were commenced in 1856, and are still in progress, so that the present is the forty-fourth year of their continuance. There are about twenty plots, two of which have been continuously unmanured, and the remainder have respectively received different descriptions or quantities of manure of known composition. A report on the “Agricultural Results” was published in the ‘Phil. Trans.,’ Part I, 1880; and a second on the “Botanical Results” in the ‘Phil. Trans.,’ Part IV, 1882. The present paper deals with a portion of the “Chemical Results.”

In all cases, of both first and second crops, the dry matter and the ash, and in most the nitrogen, have been determined. In selected cases determinations have been made of the amount of nitrogen existing as albuminoids, and in some of the amount of “crude woody fibre,” and of crude fatty matter. More than 200 complete ash-analyses have also been executed.